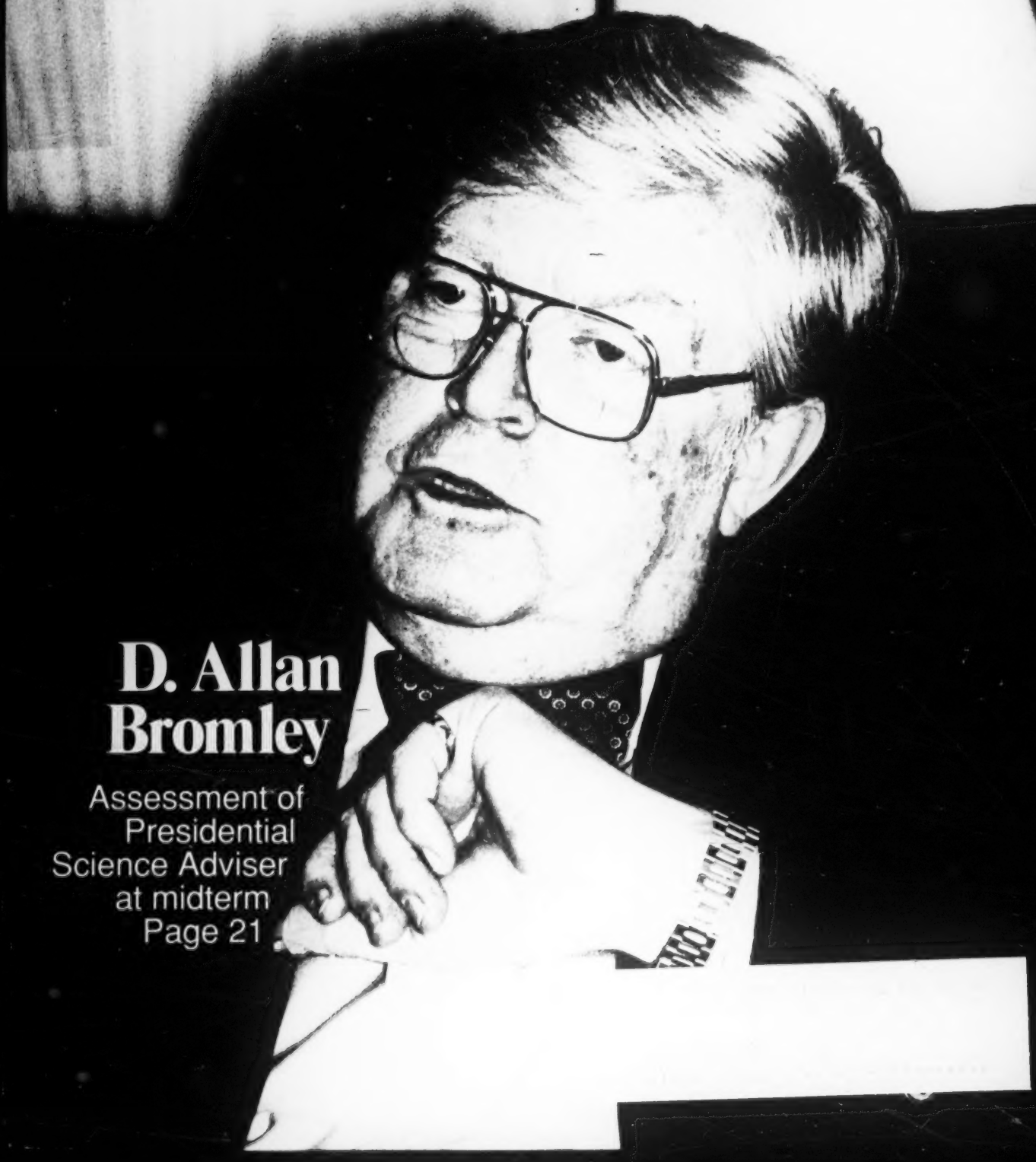
MAY 20 1991
CHEMICAL & ENGINEERING

NEWS

Chemical companies' first-quarter earnings show mixed results
Page 10



D. Allan Bromley

Assessment of Presidential Science Adviser at midterm
Page 21

CHEMICAL & ENGINEERING
NEWS
Volume 69, Number 20
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MAY 20, 1991

News of the Week

■ **President Bush pushes for global ban on chemical arms by next May and, in policy shift, says U.S. will destroy all its stocks and production facilities within 10 years of treaty's going into force.** Page 4

■ **National Transportation Safety Board approves staff report recommending tighter rules for shipping chemicals by rail as well as better training for rail workers and emergency personnel.** Page 5

■ **FMC Corp. and EPA have negotiated an agreement to phase out use of granular forms of FMC's pesticide Furadan, except for certain areas and uses, because of risk to birds.** Page 5

■ **Texas Eastern to start first pipeline transport of methyl *tert*-butyl ether, as compliance with Clean Air Act pushes up demand.** Page 6

■ **Advisory panel appointed to study FDA calls for major reforms, says agency is buried within the federal bureaucracy and suffers from chronic lack of leadership.** Page 6

Cover: Photo by C&EN's Pamela Zurer

Letters 2

Concentrates
Business 7
Government 17
Science/Technology 24

The Departments
ACS Comment 31
Meetings 55
Newscripts 56

Business

Chemical company earnings continued to fall in the first quarter, although there were a few good signs. **Page 10**

Recent fast growth of Rhône-Poulenc's U.S. arm stems in large part from its focus on specialty chemicals. **Page 14**

Rising costs are pushing ethylene producers to be more selective in their choice of feedstock. **Page 15**

Government

Congress' spring agenda features bills on trade, energy, and agency budget authorizations. **Page 18**

Sustainable farming methods, minimal use of chemical fertilizers and pesticides called for by UN group. **Page 20**

Science/Technology

Structures of two components that modulate human immune system have been determined in achievements that may lead to new immunosuppressant drugs. **Page 25**

How to improve public perception of chemistry is discussed by multinational group of chemical society presidents and officials meeting in London. **Page 27**

Education

Number of new chemistry graduates plunges again, making 1990 the seventh consecutive year of decline in B.S.-level graduates. **Page 29**

ACS News

Committee on Professional Training reports on 1990 bachelor's, master's, and Ph.D. graduates of ACS-approved schools. **Page 32**

Science Policy

At midterm, Presidential Science Adviser Bromley, who has successfully made critical technologies pivotal to evolving national science policy, is receiving high marks from Washington insiders. **Page 21**

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LETTERS

Minorities in science

The article on minorities in science (C&EN, April 15, page 20) can only be described as first class. It sweeps away the myths. As you point out, the truth is that the chief determiner of success in school is family background—mostly wealth. This has been amply demonstrated by research. As a very good example, see the article by Schiff et al. in *Science* [**200,** 1503 (1978)].

We can write new texts, train our teachers better, revise courses, etc., but all these will be of little use until we tackle the basic problem: poverty. Specifically, many minorities in the U.S. have very low incomes. (Half of all black children live below the poverty level.) Until we raise the income of all those people to a decent level they will be drastically underrepresented in science, or any profession requiring higher education.

To borrow a quote from Pogo, "We have met the enemy, and they is us."

R. Thomas Myers
Professor of Chemistry Emeritus
Kent State University

Prime source of CO_2

I read with some interest the article (C&EN, April 1, page 7) on possible causes for the greenhouse effect and unwanted emissions into Earth's atmosphere. I am sure a great deal of work has gone into estimating various industrial effluents and automobile emissions. I wonder why in all of the articles I read on the subject that there is no mention of one of the prime sources of carbon dioxide, and that is human respiration.

Just a quick calculation, based on the starting point of 200 cc per minute of carbon dioxide released by each human (at resting metabolism, according to a physiology book), this computes out to be a couple billion metric tons a year. If to the humans you add animal respiration, then that probably doubles the number, which equals or exceeds the estimates from industrial and transportation sources.

I do not want to minimize the efforts under way to decrease the amount of greenhouse gases being released into the atmosphere. Furthermore, as I said in my Otto C. Schmidt Memorial Lecture at Rose-Hulman Institute of Technology a couple of years ago, I decry the use of petroleum and other natural resources as energy producers, since their long-term value as a chemical raw material will be much more important to civilized man than the energy they produce.

However, I am suggesting putting everything into perspective. I think it is important to be aware of all of the sources adding carbon dioxide to the atmosphere, and I just wonder why no one mentions metabolism as an important source?

Henry L. Richter
Arcadia, Calif.

Supply and demand

In reading Joseph Faucher's comments (C&EN, March 25, page 3) regarding shortening the time to a Ph.D., I felt that, although he addresses an important issue, he may be missing an important point. We live in an oversupply and demand society, and it is no wonder that professional training follows the dictates of this philosophy. This approach serves the government and industry well. The more qualified people that are available in the marketplace, the easier the selection process and more moderate the remuneration.

Industry, government, and academic research institutions thrive on highly talented, cheap labor (or graduate students) to do the bulk of the research. Shortening the time to the Ph.D. would adversely affect the cost/benefits derived from such a well-established, effective system! We often do not give undergraduate students enough credit for having common sense about career choices, but they may very well be way ahead of us. The cold reality is that academia does not promise financial success following the completion of a degree program. As an old vaudevillian once said, "You pay your fee and you take your chances."

Stephen A. Davis
Hollywood, Fla.

Common meaning of chemical

None of the recent letters on the meaning of the word chemical have noted that in common usage a chemical is a substance that is understood or described in terms of its formula, molecular properties, and reactivity. When something (perhaps the same thing) is not understood or described in terms of its formula, properties, or reactivity, it is not a chemical. Water is a chemical when we predict that decomposing it

Chemical Earnings Downward Drift Continues in First Quarter

Recession is big factor; still there are some encouraging signs, with earnings and profitability up over fourth quarter of last year

William J. Storck,
C&EN Northeast News Bureau

Earnings at major chemical companies in the first quarter continued to decline on average, but there were some sparks of hope within C&EN's sample of 30 firms. Meanwhile, earnings were up at major oil companies that also produce chemicals and at pharmaceutical companies, but earnings fell at diversified firms with significant chemical operations.

Earnings for the 30 major chemical firms fell an average of 8% from the same period last year—a much better earnings performance than that of the 11 diversified manufacturers, whose earnings fell an average 26%. For the 13 oil companies surveyed, earnings were up 40% from first-quarter 1990, while at nine drug companies, earnings rose an average 50%.

The 8% earnings decline for the 30 chemical firms brought their total earnings down to almost $1.39 billion. Sales for the companies totaled almost $21.8 billion, an increase, however, of 3% over the same period in 1990. Thus, the average profit margin for the 30 companies dropped to 6.4% in the first quarter of this year from 7.1% in the first three months of last year.

Diverse factors affected the chemical industry in the first quarter. The war in the Persian Gulf, the recessionary economy at home and slowing of overseas markets, a slight downturn in raw material costs, and increasing pressure on selling prices are just a few.

The prelude to the Persian Gulf War had created uncertainty in world markets and caused raw material costs, especially for basic petrochemicals, to climb. However, the war itself eased some of those pressures—especially raw material costs, which quickly settled at or below what they had been before the Iraqi invasion of Kuwait. These costs have since risen slightly, but to nowhere near what they were before the war began.

One of the worrisome factors still affecting the industry, however, is the recession, both in the U.S. and overseas. Last year, in spite of the slowing U.S. economy, domestic producers were still able to keep demand up through exports. Industry sources say that this export market is indeed slowing considerably, especially for plastics where it had been strong. The result may well be continued declining capacity utilization, and thus declining profit margins.

As a result of declining demand and some inventory retrenchment, production went virtually nowhere in the first quarter. Production of chemicals and allied products as reported by the Federal Reserve Board increased less than 1% in the January through March period, compared with the same three months a year ago.

However, prices of chemicals and allied products moved up briskly, averaging 5.0% above the first quarter of 1990, according to the Labor Department. This is a slight easing

Chemical industry leaders for first-quarter 1991

Sales

Rank 1991		$ Millions	Rank 1990
1	Dow Chemical	$4948.0	1
2	Monsanto	2223.0	2
3	Union Carbide	1857.0	3
4	W. R. Grace	1643.0	4
5	American Cyanamid	1312.8	5
6	Hercules	768.4	6
7	Air Products	754.7	7
8	Quantum Chemical	740.2	10
9	Arco Chemical	682.0	9
10	Rohm & Haas	679.7	8

Earnings*

	$ Millions	Rank 1990
Dow Chemical	$365.0	1
Monsanto	166.0	2
American Cyanamid	104.8	3
Union Carbide	101.0	4
Air Products	62.0	6
Ethyl	52.9	8
Arco Chemical	52.0	5
International Flavors	47.0	9
Rohm & Haas	41.3	7
Morton International	40.3	10

Profitability

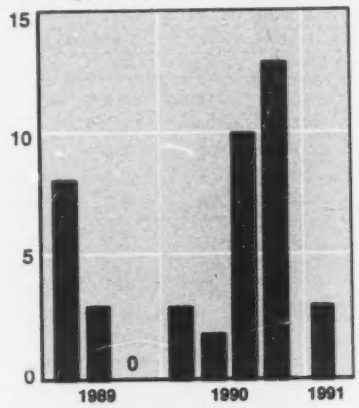
	Earnings as a % of sales	Rank 1990
International Flavors	17.4%	1
Great Lakes Chemical	12.1	3
Betz Laboratories	11.2	6
Loctite	11.0	5
Nalco Chemical	10.8	6
Vista Chemical	9.5	9
Lubrizol	9.5	14
Air Products	8.2	16
Ethyl	8.1	11
American Cyanamid	8.0	13

Note: Based on 30 chemical companies listed on page 12. a After taxes.

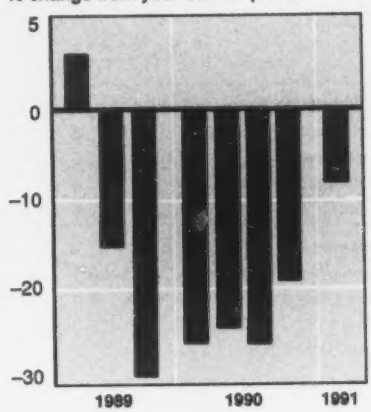
Chemical industry 1991 first-quarter results

- Sales were up just 3%
- Earnings fell 8%
- Profitability down to 6.4%
- Production was about flat
- Prices increased 5%

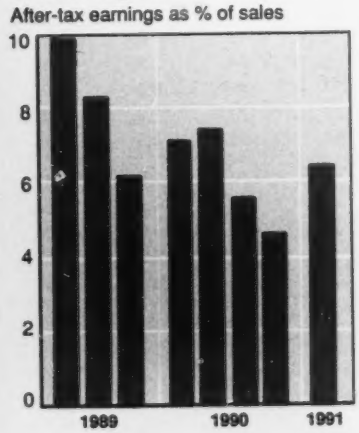
Sales
% change from year-earlier quarter



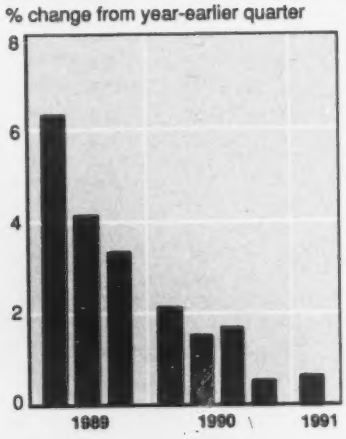
Earnings
% change from year-earlier quarter



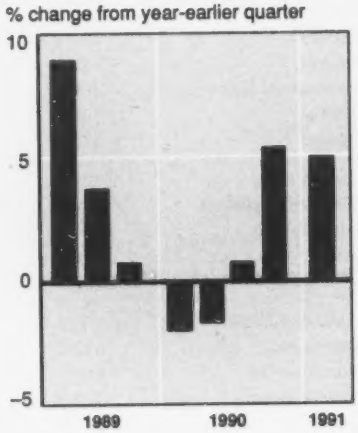
Profit margins
After-tax earnings as % of sales



Production
% change from year-earlier quarter

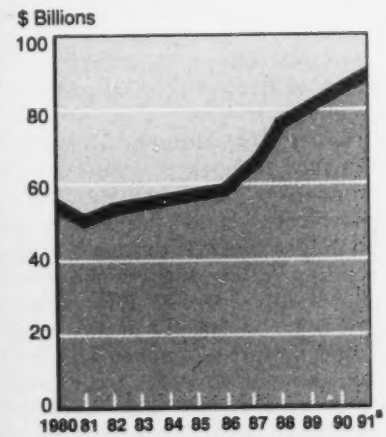


Prices
% change from year-earlier quarter

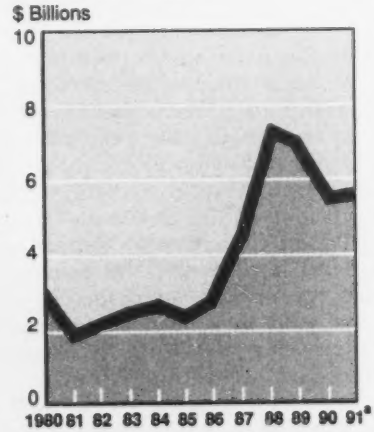


Sales in 1991 will rise about 4%, but earnings will be almost flat, lowering profit margins once again

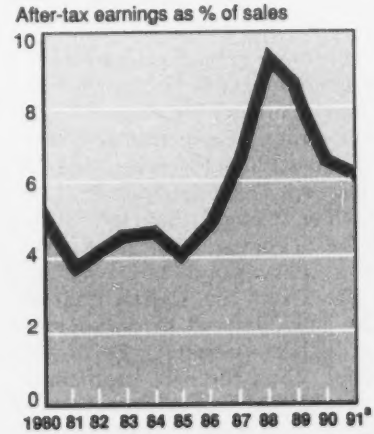
Annual sales
$ Billions



Annual earnings
$ Billions



Annual profit margins
After-tax earnings as % of sales



Note: All sales, earnings, and profit data are based on 30 chemical companies listed on page 12. a C&EN estimates.

Earnings for oil and drug firms up; diversified down

	FIRST-QUARTER 1991					
	Sales	Earnings[a]	Change from 1990		Profit margin[b]	
	($ millions)		Sales	Earnings	1991	1990
OIL AND GAS COMPANIES						
American Petrofina	$ 815.9	$ 8.3	−9%	−68%	1.0%	2.9%
Amoco	7,299.0	492.0	3	6	6.7	6.6
Ashland	2,036.2	26.6	−3	2810	1.3	0
Chevron	10,800.0	557.0	16	18	5.2	5.1
Exxon	30,685.0	2240.0	15	75	7.3	4.8
Kerr-McGee	785.6	29.7	0	10	3.8	3.4
Mobil	16,580.0	710.0	10	78	4.3	2.7
Occidental Petroleum	5,303.0	83.0	3	12	1.6	1.4
Phillips Petroleum	3,500.0	116.0	13	5	3.3	3.6
Shell Oil	5,668.0	125.0	−1	−38	2.2	3.5
Sun Co.	3,050.0	41.0	−2	0	1.3	1.3
Texaco	10,180.0	415.0	11	27	4.1	3.6
Unocal	2,717.0	53.0	3	−18	2.0	2.5
TOTAL	**$99,419.7**	**$4896.6**	**9%**	**40%**	**4.9%**	**3.8%**
DIVERSIFIED MANUFACTURERS						
Allied-Signal	$ 2903.0	$ 63.0	−5%	−51%	2.2%	4.2%
Du Pont	9,679.0	590.0	3	−4	6.1	6.5
Eastman Kodak	4,422.0	178.0	8	−11	4.0	4.8
Engelhard	628.7	21.1	−5	43	3.3	2.2
FMC	877.4	38.7	8	2	4.4	4.7
Ferro Corp.	262.9	2.9	−6	−52	1.1	2.1
3M	3,389.0	300.0	7	−10	8.9	10.6
NL Industries	225.0	−39.3	−1	def	def	10.8
PPG Industries	1,377.0	59.2	−7	−53	4.3	8.5
Tenneco	3,331.0	1.0	−8	−99	0	3.7
Vulcan Materials	197.0	−2.2	−15	def	def	8.0
TOTAL	**$27,292.1**	**$1212.3**	**1%**	**−26%**	**4.4%**	**6.1%**
PHARMACEUTICAL COMPANIES						
Abbott Laboratories	$ 1,653.6	$ 254.1	15%	13%	15.4%	15.6%
American Home Products	1,764.3	352.5	−3	12	20.0	17.3
Baxter International	2,122.0	110.0	12	def	5.2	def
Bristol-Myers Squibb	2,734.6	492.6	11	20	18.0	16.6
Merck	2,048.9	483.5	17	20	23.6	23.0
Pfizer	1,695.7	267.4	14	6	15.8	17.0
Schering-Plough	949.3	173.2	10	15	18.2	17.4
Upjohn	799.4	133.3	11	15	16.7	16.0
Warner Lambert	1,217.2	139.5	11	16	11.5	10.9
TOTAL	**$14,985.1**	**$2406.1**	**11%**	**50%**	**16.1%**	**11.9%**

a Earnings from operations excluding significant nonrecurring and extraordinary items. b Earnings as a percentage of sales. def = deficit.

12.1% from 13.6% in the first quarter last year.

Betz Laboratories reported earnings growth of 19% on a 14% increase in sales, and company chairman and chief executive John F. McCaughan stated, "We are especially pleased with our results, considering that they were achieved during a recessionary period. Both domestic and foreign operations contributed to our strong first-quarter performance."

Air Products & Chemicals, one of the chemical firms that does not fall into the smaller company category but which showed improvement, reported earnings growth of 14% on a 6% sales increase. And profitability rose to 8.2% from 7.6% in the first three months last year. Chairman Dexter F. Baker said, "Air Products' results were very good despite the increasing impact of the recession in the U.S. and evidence that economic activity has slowed throughout the world."

Not all companies were so fortunate, however. J. Lawrence Wilson, chairman of Rohm & Haas, where earnings dropped 24% on a 2% sales decrease, said: "The full impact of the U.S. recession and the European economic slowdown hit us full force in the middle of the quarter. Shipping volumes fell behind 1990 and continued at a lower pace through the end of the quarter. The plastics businesses particularly were hard hit in major markets. All businesses, except biocides and formulation chemicals, were hurt by external economic activity."

Dow Chemical, despite a 21% decline in earnings from operations, remained modestly optimistic. According to president and chief executive officer Frank Popoff, the global economy remains weak, although there is modest growth, primarily in the Pacific and continental Europe. "The weighted average growth of the 80 countries in which Dow does business should average between 0.5% and 1.0% in 1991, down from nearly 2% in 1990," Popoff said. And he sounded the hope of most of the industry: "The challenge of maintaining margins in an environment of soft economies and weak industry fundamentals typifies the current year. We anticipate modest improvement in 1992 versus 1991, based on the U.S. economy returning to positive growth by mid-1991."

Oil companies with large chemical operations followed the industry trend with mixed results. For instance, Exxon reported that earnings from its chemical operations climbed 23% to $223 million when compared with the year-earlier quarter. Mobil's chemical earnings rose 11% to $92 million in the first quarter. And Texaco had a 6% increase to $17 million.

Not all were so fortunate, however. Earnings at Shell, for instance, dropped 28% to $71 million.

Among the diversified firms, Du Pont, the largest U.S. chemical producer, saw earnings from its chemicals, polymers, and fibers operations fall almost 32% to $278 million. □

Costs creating ethylene feedstock problems

By the end of the year, cash cost economics will be setting ethylene prices. And this phenomenon will continue at least through 1993.

This means U.S. ethylene producers will face even greater pressure to minimize production costs. It also means that they will have to be more selective in choosing their feedstock.

That's the message that Thomas H. McGreevey brought to the recent meeting of the Chemical Management & Resources Association (CMRA) meeting in Philadelphia. McGreevey, director of CPI Consulting Associates, White Plains, N.Y., unloaded a few surprises at CMRA's review and forecast meeting.

For instance, light naphtha and gas oil will be more competitive than ethane as an ethylene feedstock, says McGreevey. In fact, he expects ethane to be the least competitive of all possible feedstocks.

For ethylene producers, oscillating feedstock economics is nothing new. They have been living with it for decades. Until the 1960s, the U.S. olefins industry was built on an abundant supply of natural gas liquid (NGL). Then, concerned about the future availability of NGL, some companies built ethylene crackers based on heavy liquids.

The crude oil crises of 1973 and 1979 forced producers to become more flexible. They revamped their heavy-liquids crackers to use a variety of feedstocks.

By the late 1980s, the U.S. petrochemical industry was operating at full capacity. By then, heavy liquids had become the feedstock of choice, says McGreevey.

Signs of weakness started to show up in petrochemical profits during the second half of 1989. They're still there, despite a temporary respite as a result of the Mideast crisis.

Meanwhile, higher crude prices during the second half of 1990 affected the competitive relationship between light and heavy feedstock, McGreevey says. But he thinks that an olefins producer's ability to switch from one feedstock to another as feedstock prices change will mean more competition—and a smaller price differential—among feedstocks.

Given this feedstock flexibility, price, more than availability, will be the key to feedstock choice in the 1990s, says McGreevey. That "nice generalization" is subject to several constraints, however. Heavy-liquids crackers, for instance, are flexible, but they cannot swing predominately to light liquids.

In addition, a company's ability to consume or market coproducts—and the value of those coproducts—can influence feedstock options. Constraints such as these can set the competitive relationship of feedstocks on its ear, as they did last year.

McGreevey sees three factors affecting an olefins producer's choice of feedstock over the next few years. They are domestic production of natural gas, reformulation of gasoline to meet Clean Air Act standards, and the price of crude oil and natural gas.

Forecasts of U.S. natural gas demand have ranged from virtually no growth to increases of as much as 2% per year. McGreevey leans toward the 2% growth scenario. He estimates that domestic natural gas output will increase from 18.9 trillion cu ft in 1990 to 20.9 trillion cu ft in 1995.

He concedes that his forecast may be optimistic because natural gas imports from Canada are expected to increase by 1995. Nevertheless, he says NGL availability should not be materially affected if domestic production comes in slightly lower. The reason is an anticipated increase in recovery efficiency.

Based on this forecast, McGreevey says that about 520,000 to 530,000 barrels per day of ethane probably will be available to the petrochemical industry. That's higher than 1989–90 levels, but consistent with that of prior years.

Over the past five years, refiners have increased propane availability 7% annually. Refineries now account for 45% of total supply. McGreevey says that, over the next five years, 510,000 to 520,000 bbl per day of propane will be available from gas-processing plants.

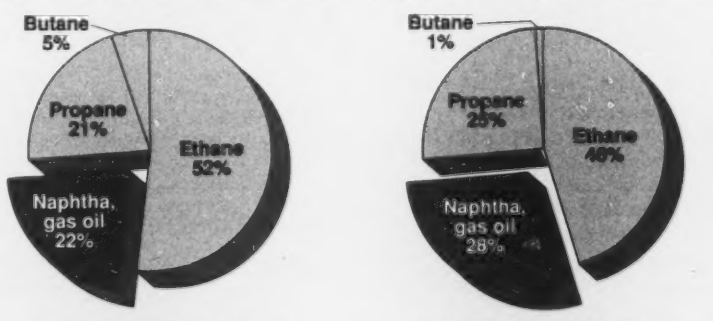
U.S. refineries and imports will have to supply the remaining 600,000 bbl per day. Although he says this appears reasonable, he believes an opportunity to improve profit margins probably will mean higher prices for petrochemical buyers.

n-Butane and isobutane are "probably the most interesting segment" of the NGL market, says McGreevey. He estimates that the gas-processing industry probably will produce 320,000 to 330,000 bbl per day of butanes in 1995, about 5% more than it is producing today.

In addition, refineries and imports have been adding about 150,000 to 200,000 bbl per day to U.S. supply recently. Now, with the Environmental Protection Agency mandating lower gasoline vapor pressure, butanes will be pulled out of gasoline. McGreevey estimates that, starting next year, an additional 150,000 bbl per day of *n*-butane will be available from the gasoline pool.

As a result, McCreevey estimates that the petrochemical industry could have available about 250,000

Ethylene producers will be using more heavy feedstock



1990 ethylene production = 37.6 billion lb

1995 ethylene production = 44.2 billion lb

Source: CPI Consulting Associates

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bbl per day of *n*-butane as feedstock in 1995. This assumes that refiners will continue to use all of their isobutane as alkylate and that Atlantic Richfield and Texaco will use 45,000 to 50,000 bbl per day for propylene oxide.

McGreevey also assumes that only 120,000 bbl per day of *n*-butane will be used for gasoline blending starting next year. And an additional 15,000 bbl per day will go into maleic anhydride and acetic acid.

Although there should be about 250,000 bbl per day of surplus *n*-butane available, McGreevey doesn't think that much of it will be used as feedstock for ethylene crackers. One reason is that not all of the *n*-butane backed out of the gasoline pool will be available on the Gulf Coast.

Another reason is the drive to build methyl *tert*-butyl ether (MTBE) capacity in the U.S. as refiners strive to meet ozone nonattainment regulations of the Clean Air Act. Although isomerization and dehydrogenation are the most expensive routes to isobutylene, *n*-butane appears to be the only alternative able to produce the 300,000 to 350,000 bbl per day of MTBE that will be needed to meet ozone and carbon monoxide nonattainment regulations.

As a result, the amount of light liquids available for ethylene in 1995 will account for slightly more than 70% of ethylene output. The remainder, says McGreevey, will come from naphtha and gas oil, with naphtha capturing about two thirds of the required feedstock.

His forecast assumes a moderate rise in crude oil prices (to $23 per bbl), reasonable economic growth, and ethylene output increasing at an annual growth rate of 3.3%.

The major unanswered question is: What kinds of feedstocks will be coming out of refineries as a result of the Clean Air Act? It is not yet clear how refiners will solve their need to meet future EPA requirements.

Will their oxygenate requirements be met solely by MTBE? Or will there be a combination of MTBE, ETBE (ethyl *tert*-butyl ether), ethanol, and methanol? The answers to these questions will help dictate ethylene's feedstock picture.

Earl Anderson

Number of New Chemistry Graduates Plunges Again

Last year was the seventh consecutive year of decline in B.S.-level graduates as fewer undergraduates opt for chemistry as a major

Michael Heylin, C&EN Washington

The nosedive in the number of new chemistry graduates earning bachelor's degrees continued last year. Even the number of new women chemists with bachelor's degrees is now in steady decline after a long period of growth. And it is apparent that native born American men today find chemistry far less attractive as an undergraduate major than they did even five years ago.

These are some of the major trends that can be gleaned from the data in the latest annual report of the American Chemical Society's Committee on Professional Training (CPT). The report (see page 32) lists the number of bachelor-, master-, and doctoral-level chemists who graduated during the 1989–90 academic year from departments with undergraduate chemistry programs approved by ACS. In recent years these departments have accounted for between 89 and 93% of all new B.S.-level chemists in the U.S. as well as for essentially all new M.S. and Ph.D. chemists.

At the advanced degree level, the picture is somewhat different. This is at least partly due to a much higher presence of foreign students. The number of new Ph.D. chemists increased last year for the 12th successive year. And the number of new M.S.-level chemists, although down last year, has held reasonably steady for the past decade.

One quarter of last year's new Ph.D. chemists were women. This was up from one fifth in 1984–85. Of the new M.S. graduates, 37% were women, up from 32% five years earlier.

The 599 departments with CPT-approved programs graduated 7650 chemists with B.S. degrees in 1989–90. This was down from 8125 one year earlier. It represented a drop of 21% from the 9679 graduates five years earlier in 1984–85, and was the seventh consecutive year of decline.

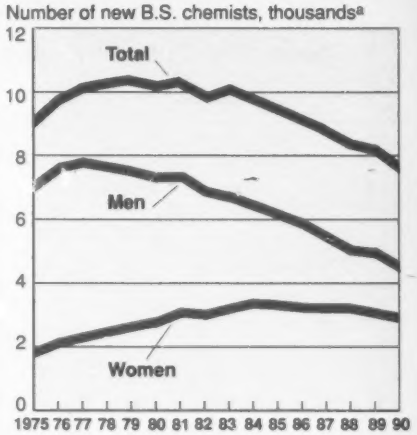
The decline for male graduates earning B.S. chemistry degrees has been particularly sharp. Last year such graduates totaled 4614. This was down 26% from the 6263 who graduated in 1984–85 and represented a 42% decline from the high of 7903 in 1976–77.

Women have taken up some of the slack. In 1989–90 they represented 40% of the graduating B.S.-level chemists. This was up from 28% 10 years earlier and from 16% 20 years earlier. But in absolute terms, the number of women earning bachelor's chemistry degrees peaked in 1985 at 3416. It has been slipping since. Last year it was 3036, 11% below the 1985 level.

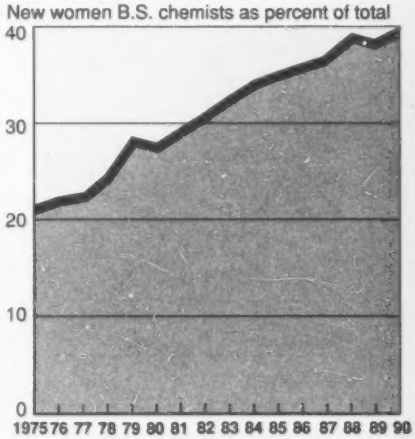
The decline in the number of B.S.-level chemistry graduates has affected most schools, even the largest and most prestigious. For many years, C&EN has identified from the CPT report and ranked the 25 largest producers of all bachelor's, ACS-certified bachelor's, master's, and doctoral degree chemistry graduates.

In 1984–85 the listing for B.S.-level chemistry graduates ranked the top 27 departments, since there was a four-way tie for the 24th place. All but one of these departments had smaller graduating classes in 1989–90. The exception was the University of Illinois, Urbana-Champaign, with 102 graduates in 1984–85 and 120 last year. The total for all 27 departments dropped 31% over this five-year period, from 1945 to 1343. Particularly big drops were posted

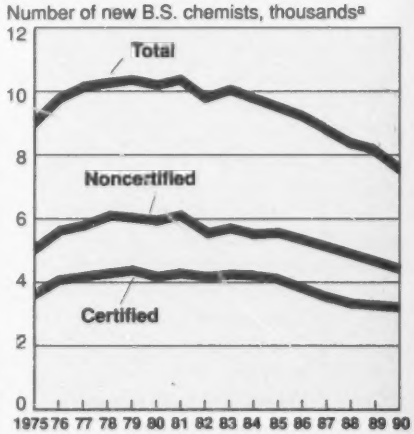
Men shy away from chemistry, women take up some slack . . .



. . . and account for an increasing share of new graduates . . .



. . . while gap between certified, noncertified degrees narrows



a Number of B.S. chemistry degrees granted by departments with undergraduate chemistry programs approved by ACS's Committee on Professional Training.

These schools had the most chemistry graduates, 1989–90

Total bachelor graduates

1.	Indiana U	132
2.	U of Illinois, Urbana-Champaign	120
3.	U of California, Los Angeles	83
4.	U of Texas, Austin	75
5.	U of Virginia	70
6.	U of Pittsburgh	68
7.	North Carolina State U	65
8.	U of California, Berkeley	59
9.	U of California, San Diego	57
10.	U of Maryland, College Park	55
11.	U of California, Irvine	51
12.	California State U, Long Beach	50
12.	U of Puerto Rico, Rio Piedras	50
14.	Miami U	49
14.	Youngstown State U	49
16.	U of Colorado, Boulder	48
17.	U of North Carolina, Chapel Hill	47
17.	U of South Florida	47
19.	U of Delaware	43
19.	Illinois State U	43
19.	Ohio State U	43
19.	U of Washington	43
23.	Case Western Reserve U	42
24.	Duke U	40
25.	U of Kansas	38
25.	West Virginia U	38

Certified bachelor graduates

1.	U of Texas, Austin	75
2.	U of Illinois, Urbana-Champaign	43
2.	Ohio State U	43
4.	Illinois State U	40
5.	U of California, San Diego	32
6.	Massachusetts Inst of Tech	31
6.	U of Minnesota, Minneapolis	31
8.	U of Delaware	30
8.	Harvard U	30
10.	U of Washington	29
11.	U of Cincinnati	28
11.	U of Michigan, Ann Arbor	28
13.	U of California, Davis	26
13.	Indiana U	26
13.	U of South Florida	26
13.	C of William & Mary	26
17.	North Carolina State U	25
18.	Carnegie Mellon U	22
18.	U of Wisconsin, Madison	22
20.	U of North Carolina, Chapel Hill	21
20.	Rensselaer Polytechnic Inst	21
20.	San Diego State U	21
23.	U of Akron	19
23.	California State U, Long Beach	19
25.	U of Chicago	18

Master graduates

1.	Cornell U	36
2.	Northwestern U	29
3.	Princeton U	28
4.	U of California, San Diego	25
5.	U of Rochester	24
6.	Ohio State U	23
7.	Yale U	21
8.	U of Washington	19
9.	U of Michigan, Ann Arbor	18
10.	Columbia U	17
10.	Illinois State U	17
12.	U of California, Los Angeles	16
12.	Indiana U	16
12.	San Jose State U	16
15.	Bowling Green State U	14
15.	U of Illinois, Urbana-Champaign	14
15.	U of Oklahoma	14
15.	Seton Hall U	14
19.	U of California, Berkeley	13
19.	Rensselaer Polytechnic Inst	13
19.	U of Cincinnati	13
19.	Harvard U	13
19.	Indiana/Purdue U, Indianapolis	13
24.	Johns Hopkins U	12
24.	Rutgers U, New Brunswick	12
24.	Washington U	12

Doctoral graduates

1.	U of California, Berkeley	67
2.	Massachusetts Inst of Tech	55
3.	Purdue U	50
4.	U of Wisconsin, Madison	47
5.	U of Illinois, Urbana-Champaign	44
6.	Texas A&M	42
7.	Iowa State U	34
7.	U of North Carolina, Chapel Hill	34
9.	U of California, Santa Barbara	32
9.	Indiana U	32
11.	U of California, Los Angeles	31
11.	Ohio State U	31
13.	Northwestern U	30
13.	Yale U	30
15.	Cornell U	29
15.	Harvard U	29
17.	Michigan State U	28
18.	U of Florida	27
19.	U of Colorado, Boulder	26
19.	U of Michigan, Ann Arbor	26
21.	U of Chicago	25
22.	Colorado State U	24
22.	U of Maryland, College Park	24
22.	U of Minnesota, Minneapolis	24
22.	U of South Carolina	24

by the University of Miami, from 99 to 21; the University of North Carolina, Chapel Hill, from 114 to 47; and Emory University, from 83 to 34.

Sixteen departments are common to the rankings of the top producers of bachelor's degree chemists for 1984–1985 and 1989–90. In 1984–85 these 16 graduated a total of 1240. Last year they graduated 1003, 19% fewer.

Last year was the sixth year in a row in which Indiana University produced the most B.S.-level chemistry graduates. The University of Illinois, Urbana-Champaign, hung onto second place, and the University of California, Los Angeles, moved up from fourth to third.

The biggest producer of ACS-certified B.S. graduates last year was the University of Texas, Austin, up from second in 1988–89. The second spot was shared by the University of Illinois, Urbana-Champaign, and Ohio State University. ACS-certified graduates, who in recent years have represented about 42% of all B.S.-level chemistry graduates, are immediately eligible for membership in ACS. They have completed a curriculum that meets guidelines specified by the society.

Last year was also the sixth year in a row in which the University of California, Berkeley, was the largest producer of doctoral chemists. Berkeley has topped this list for nine of the past 17 years. For the other eight years, the honor has gone to the University of Illinois, Urbana-Champaign, which was fifth last year. Massachusetts Institute of Technology graduated the second largest total of doctoral chemists last year, moving up from third in 1988–89. Purdue University made the reverse change, slipping from second to third.

Cornell University moved up from second to top the ranking for master's degree chemists. Northwestern University, leader in 1988–89, moved to second.

The University of Illinois, Urbana-Champaign; Indiana University; and Ohio State University had the only three departments to appear on last year's top 25 rankings for all categories—bachelor's, certified bachelor's, master's, and Ph.D. □

ACS Committee on Professional Training 1990 Annual Report

The number of bachelor's degree graduates in chemistry from colleges and universities whose undergraduate chemistry programs are approved by the American Chemical Society decreased 5.8% in the 1989–90 academic year. This almost doubled the loss of last year. The number of master's degrees from these departments dropped 6.1% after an increase of 7.5% last year. The number of Ph.D. degrees continued to increase for the 12th year in a row; the increase was 8.2%.

The percentage of baccalaureate graduates certified to ACS was 42%, about the same as previous years. (Certified graduates are those who have completed a curriculum that meets the guidelines specified by ACS and are eligible for full membership in ACS; noncertified graduates may become associate members of ACS upon graduation and full members after three years of professional experience or after obtaining a higher degree in a chemical science.)

A total of 2151 of the baccalaureate graduates from the approved schools were reported as planning to go to graduate school, and 1567 reported plans to go to professional schools.

Total numbers of bachelor's degrees (certified and noncertified), master's degrees, and Ph.D. degrees awarded in 1989–90 by departments whose undergraduate chemistry programs are ACS approved are listed by institution in the large table at the end of this report and are summarized in the two smaller tables. These tables also include numbers of chemical engineering graduates from institutions whose programs are accredited by the American Institute of Chemical Engineers and the Accreditation Board for Engineering & Technology. (Note: These departments are not required to report their data to the Committee on Professional Training, so the number of departments included varies each year.) Included for the sixth year is a table with information on graduate student enrollments in chemistry departments whose undergraduate programs are ACS approved.

The number of bachelor's degrees in chemical engineering from the 126 AIChE-ABET-accredited departments that reported in 1990 increased 9.6% from the total reported by 115 departments in 1989, the first increase in seven years. At the graduate level, the number of chemical engineering master's degrees increased for the first time in five years and Ph.D. degrees showed a slight increase over last year. The number of master's degrees was up 4% from 1989, and the number of Ph.D.s was up 1.5%.

The chemistry programs at ACS-approved schools normally are reevaluated at five-year intervals. There were 599 colleges and universities on the approved list at the end of 1990. During the year the committee studied the reports of 303 chemistry programs at approved schools and 20 reports from schools applying for ACS approval. Each evaluation involved a review of extensive documentary materials submitted by the

Summary of data from departments offering an ACS-approved program, 1986–90

	Bachelors				Masters		Doctorates	
	Number of schools	Graduates (totals)	Certified graduates[a]	Noncertified graduates	Number of schools	Graduates	Number of schools	Graduates
CHEMISTRY								
1986	580	9295	3892	5403	315	1620	187	1885
1987	582	8848	3663	5185	316	1636	188	1936
1988	584	8372	3453	4919	319	1584	192	1955
1989	593	8125	3384	4741	318	1710	189	1970
1990	599	7650	3213	4437	317	1605	187	2131
CHEMICAL ENGINEERING[b]								
1986	118	5229	5229	—	116	1244	103	460
1987	107	4435	4435	—	103	1078	90	533
1988	128	3524	3524	—	124	1036	106	603
1989	115	2891	2981	—	113	919	95	574
1990	126	3170	3170	—	122	956	106	583

a Includes graduates certified in approved options. b Chemical engineering departments are not required to report their data to CPT, so the number of departments included in this category varies from year to year.

Summary of totals from 1990 reports from departments offering an ACS-approved program

	Schools reporting	Men	Women	Total
CHEMISTRY				
Bachelors, Total	599	4614	3036	7650
Certified		1986	1227	3213
Noncertified		2628	1809	4437
Masters	317	1007	598	1605
Doctorates	187	1607	524	2131
CHEMICAL ENGINEERING				
Bachelors, Certified	126	2217	953	3170
Masters	122	784	172	956
Doctorates	106	508	75	583

department chairman describing the current status of the program.

Six schools were added to the ACS-approved list by CPT in 1990; three were put on probation; seven were removed from probation; four continued on probation; and none was removed from the list. Visiting associates of the committee made on-site visits to nine schools.

In 1990 the committee added two more options to the list of certified degrees. Currently students may receive certified degrees in chemistry with options in biochemistry, polymers, chemistry education, chemical physics, or materials. By the end of 1990, the committee had approved 23 programs with a biochemistry option; three with a polymers option; and one chemistry education option.

CPT presented a symposium on "Innovative Approaches to the Teaching of Introductory Chemistry" in cooperation with the ACS Division of Chemical Education and the National Science Foundation at the fall 1990 ACS national meeting. The symposium focused on the critical need for curricular revision of the general chemistry programs at U.S. colleges and universities and examined the feasibility and vitality of nontraditional approaches to teaching introductory chemistry. Proceedings of the symposium will be available this spring and will be distributed to all ACS-approved schools. Copies may be requested from: Office of Professional Training, American Chemical Society, 1155—16th St., N.W., Washington, D.C. 20036.

As an added service to the users of the "ACS Directory of Graduate Research," the committee approved an on-line version of the directory on ACS/ECOM. All data elements in the DGR, except publications, are searchable in the on-line system. Information on accessing this database may be obtained from Cathi Buzalski, ACS/ECOM System Administrator, 1155—16th St., N.W., Washington, D.C. 20036, (800) 227-5558 or (202) 872-6016.

Also, as an aid to undergraduate students studying chemistry, the committee published a revised fifth edition of the booklet titled Planning for Graduate Work in Chemistry. This helpful publication addresses the reasons for going to graduate school, the admission process, choice of graduate school, how and when to apply, availability of financial support, and preparation for graduate school. Copies of Planning for Graduate Work in Chemistry are available from the Office of Professional Training, American Chemical Society, 1155—16th Street, N.W., Washington, D.C. 20036.

Other CPT activities in 1990 included approval of a "Research Reports" appendix to the guidelines for ACS-approved schools; publication of issue number six of the *CPT Newsletter*; inauguration of a plan to revise existing appendixes to the "ACS Guidelines & Evaluation Procedures"; discussion of a proposal for changes in CPT data compilation and analysis; and continuation of development of a subject index in the "ACS Directory of Graduate Research."

CPT wishes to acknowledge and thank the following visiting associates of the committee who conducted on-site visits to schools on the approved list or applying for ACS approval during 1990: Charles A. Arrington Jr., Furman University; Slayton A. Evans, University of North Carolina, Chapel Hill; Quintus Fernando, University of Arizona; Dennis J. Fife, Thiokol Corp.; Donald E. Jones, Western Maryland College; J. Ivan Legg, Auburn University; John P. Lowe, Pennsylvania State University; Robert W. Parry, University of Utah; Herman G. Richey, Pennsylvania State University; and Charles A. Root, Bucknell University. □

Committee members, 1990

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Oberlin College
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Barbara A. Gallagher, *committee secretary*
Cathy A. Nelson, *staff associate*
Dolphine S. Hite, *program assistant*
American Chemical Society

Graduate student enrollments in departments whose undergraduate chemistry programs are ACS approved

	Number of departments	First-year graduate students		All graduate students	
		Full-time	Part-time	Full-time	Part-time
M.S. DEPARTMENTS[a]					
Fall 1985	129	417	292	1,106	962
Fall 1986	128	474	264	1,190	1051
Fall 1987	127	406	315	1,136	993
Fall 1988	127	420	218	998	855
Fall 1989	131	429	238	1,013	834
Ph.D. DEPARTMENTS					
Fall 1985	187	3455	208	14,379	1372
Fall 1986	187	3475	235	14,438	1355
Fall 1987	192	3441	201	15,212	1231
Fall 1988	189	3320	171	15,125	1111
Fall 1989	187	3464	159	15,222	1207

a Departments whose highest offering is the master's degree in chemistry.

Chemistry and chemical engineering degrees awarded by schools offering an ACS-approved program, 1989–90

	CHEMISTRY				CHEMICAL ENGINEERING		
	Bachelors certified						
	Yes	No	M.S.	Ph.D.	B.S.	M.S.	Ph.D.
Abilene Christian U	7	3	1	0			
Adelphi U	0	2	4	—			
Agnes Scott C	1	0	—	—			
Akron, U of	19	7	5	5	a		
Alabama, U of							
Birmingham	2	3	2	6			
Huntsville	1	4	6	—	a		
Tuscaloosa	1	12	1	8	19	9	0
Alaska Fairbanks, U of	2	7	2	—			
Albion C	1	14	—	—			
Albright C	5	9	—	—			
Alfred U	3	0	—	—			
Allegheny C	0	11	—	—			
Alma C	3	3	—	—			
American U	2	0	4	2			
Amherst C	1	9	—	—			
Andrews U	2	1	—	—			
Appalachian State U	4	11	0	—			
Arizona State U	15	10	3	13	25	4	5
Arizona, U of	12	10	4	13	13	3	1
Arkansas State U	0	7	0	—			
Arkansas Tech U	3	2	—	—			
Arkansas, U of							
Fayetteville	4	6	4	9	33	10	2
Little Rock	3	7	2	—			
Ashland U	0	3	—	—			
Auburn U	2	9	6	3	21	21	4
Augsburg C	2	1	—	—			
Augustana C							
Illinois	0	9	—	—			
South Dakota	2	2	—	—			
Austin C	0	6	—	—			
Baldwin-Wallace C	2	9	—	—			
Ball State U	4	3	2	—			
Barnard C	0	18	—	—			
Bates C	2	6	—	—			
Baylor U	7	29	1	0			
Beloit C	2	13	—	—			
Bemidji State U	3	13	—	—			
Birmingham-Southern C	3	1	—	—			
Bloomsburg U	5	4	—	—			
Boston C	6	0	3	5			
Boston U	9	10	5	5			
Bowdoin C	1	27	—	—			
Bowling Green State U	7	9	14				
Bradley U	3	3	0	—			
Brandeis U	0	1	6	8			
Bridgeport, U of	0	0	3	—			
Bridgewater State C	2	4	1	—			
Brigham Young U	16	13	5	4	26	8	5
Brown U	0	14	1	14	1	0	1
Bryn Mawr C	11	0	6	1			
Bucknell U	14	18	2	—	21	4	—
Butler U	3	9	1	—			
California Institute of Tech	6	0	2	21	5	4	14
California Poly State U	7	28	2	—			
California State Poly U	8	10	5	—	a		
California State U							
Bakersfield	1	4	—	—			
Chico	0	6	—	—			
Dominguez Hills	2	4	—	—			
Fresno	7	5	5	—			
Fullerton	4	21	4	—			
Hayward	13	12	5	—			
Long Beach	19	31	10	—	a		
Los Angeles	2	13	4	—			
Northridge	7	21	10	—			
Sacramento	9	8	6	—			
San Bernardino	2	5	—	—			
Stanislaus	5	9	—	—			
California, U of							
Berkeley	11	48	13	67	71	13	15
Davis	26	7	4	14	28	5	3
Irvine	13	38	10	22			
Los Angeles	11	72	16	31	15	5	8
Riverside	12	0	3	11			
San Diego	32	25	25	19	17	8	1
Santa Barbara	15	0	8	32	21	7	7
Santa Cruz	6	12	3	9			

	CHEMISTRY				CHEMICAL ENGINEERING		
	Bachelors certified						
	Yes	No	M.S.	Ph.D.	B.S.	M.S.	Ph.D.
Calvin C	5	11	—	—			
Canisius C	5	5	—	—			
Capital U	2	2	—	—			
Carleton C	8	11	—	—			
Carnegie Mellon U	22	3	7	6	29	11	12
Carroll C	4	9	—	—			
Carthage C	1	1	—	—			
Case Western Reserve U	5	37	6	19	25	5	4
Catholic U of America	0	2	3	3			
Centenary C of Louisiana	1	2	—	—			
Central C	0	9	—	—			
Central Connecticut State U	4	2	0				
Central Florida, U of	15	0	4	—			
Central Michigan U	0	18	3	—			
Central State U							
Ohio	0	2	—	—			
Oklahoma	5	13	—	—			
Centre C	2	5	—	—			
Charleston, C of	4	10	—	—			
Chatham C	3	0	—	—			
Chestnut Hill C	3	2	—	—			
Chicago State U	0	4	—	—			
Chicago, U of	18	12	11	25			
Christian Brothers C[b]					a		
Cincinnati, U of	26	0	13	19	47	5	4
Citadel, The	0	4	—	—			
City U of New York							
Graduate Center	—	—	—	7			
Brooklyn C	0	17	10	—			
City C	2	15	11	—	11	13	3
Herbert H. Lehman C	1	10	—	—			
Hunter C	[redacted]		—	—			
Queens C	0	14	4	—			
Clarion U	3	1	—	—			
Clark U	3	2	2	2			
Clarkson U	6	2	5	10	38	19	4
Clemson U	6	0	4	5	40	6	2
Cleveland State U	13	0	8	8	14	4	4
Coe C	0	2	—	—			
Colby C	2	8	—	—			
Colgate U	10	4	—	—			
Colorado C	8	4	—	—			
Colorado School of Mines	5	0	6	5	52	14	1
Colorado State U	10	5	1	24	20	7	0
Colorado, U of							
Boulder	12	36	8	26	31	8	3
Colorado Springs	4	2	—	—			
Denver	4	3	1	—			
Columbia U	4	4	17	20	18	15	5
Concordia C	1	4	—	—			
Connecticut C	3	7	—	—			
Connecticut, U of	13	7	6	10	20	13	3
Cooper Union[b]					a		
Cornell C	0	4	—	—			
Cornell U	16	15	36	29	31	4	7
Creighton U	15	6	0	—			
Dartmouth C	0	13	2	6			
David Lipscomb U	1	14	—	—			
Davidson C	5	5	—	—			
Dayton, U of	5	3	—	—	25	3	—
De Paul U	2	8	7	—			
DePauw U	4	9	—	—			
Delaware State C	1	5	2	—			
Delaware Valley C of Science & Agriculture	3	0	—	—			
Delaware, U of	30	13	3	15	33	5	16
Delta State U	2	7	—	—			
Denison U	3	2	—	—			
Denver, U of	0	6	2	2			
Detroit Mercy, U of	1	3	7	3	a		
Dickinson C	1	17	—	—			
District of Columbia, U of the	3	2	—	—			
Drake U	3	3	—	—			
Drew U	2	5	—	—			
Drexel U	5	2	8	4	38	7	1
Duke U	11	29	3	19			
Duquesne U	0	7	1	0			
Earlham C	0	8	—	—			
East Carolina U	6	3	4	—			

	CHEMISTRY				CHEMICAL ENGINEERING		
	Bachelors certified						
	Yes	No	M.S.	Ph.D.	B.S.	M.S.	Ph.D.
East Stroudsburg U	2	9	0	—			
East Tennessee State U	4	4	3	—			
East Texas State U	0	1	3	—			
Eastern Illinois U	9	6	3	—			
Eastern Kentucky U	0	13	3	—			
Eastern Michigan U	6	10	6	—			
Eastern New Mexico U	3	1	0	—			
Eckerd C	2	1	—	—			
Elizabethtown C	1	7	—	—			
Elmhurst C	2	6	—	—			
Emory U	3	31	4	17			
Emporia State U	3	1	5	—			
Evansville, U of	2	1	—	—			
Fairfield U	3	0	—	—			
Fairleigh Dickinson U							
Madison	3	0	4	—			
Teaneck	7	0	0	—			
Fisk U	3	0	3	—			
Florida A&M U	0	2	—	—			
Florida Atlantic U	5	14	4	—			
Florida Institute of Tech	1	3	0	0	6	5	—
Florida International U	4	7	0	—			
Florida State U	3	21	5	11	a		
Florida, U of	5	27	6	27	36	6	7
Fordham U	2	4	1	—			
Fort Lewis C	1	12	—	—			
Framingham State C	2	1	—	—			
Franklin & Marshall C	10	4	—	—			
Furman U	14	10	0	—			
Geneva C	2	11	—	—			
George Mason U	8	0	1	—			
George Washington U	2	7	0	2			
Georgetown U	11	0	5	7			
Georgia Institute of Tech	17	0	9	6	55	8	8
Georgia Southern U	2	0	—	—			
Georgia State U	0	5	0	—			
Georgia, U of	8	7	4	7			
Gettysburg C	4	1	—	—			
Glassboro State C	5	1	—	—			
Gonzaga U	2	0	—	—			
Goucher C	0	4	—	—			
Grand Valley State U	1	14	—	—			
Grinnell C	5	10	—	—			
Gustavus Adolphus C	1	7	—	—			
Hamilton C	1	2	—	—			
Hamline U	3	4	—	—			
Hampden-Sydney C	2	2	—	—			
Hampton U	9	0	3	—			
Hartford, U of	3	0	0	—			
Hartwick C	2	1	—	—			
Harvard U	30	0	13	29			
Harvey Mudd C	12	0	—	—			
Haverford C	15	1	—	—			
Hawaii, U of	10	7	5	2			
Hendrix C	4	8	—	—			
Hiram C	3	3	—	—			
Hobart & William Smith C	0	7	—	—			
Hofstra U	2	3	—	—			
Hollins C	0	3	—	—			
Holy Cross, C of the	15	3	—	—			
Hope C	14	9	—	—			
Houston, U of	5	1	5	13	17	7	9
Howard U	1	21	1	1	5	4	—
Humboldt State U	3	2	—	—			
Idaho State U	6	4	0	—			
Idaho, U of	6	8	6	3	12	8	1
Illinois Benedictine C	13	0	—	—			
Illinois Institute of Tech	4	0	1	0	25	5	12
Illinois State U	40	3	17	—			
Illinois Wesleyan U	4	1	—	—			
Illinois, U of							
Chicago	8	22	10	15	20	7	1
Urbana-Champaign	43	77	14	44	56	9	12
Indiana State U	7	0	3	—			
Indiana U	26	106	16	32			
Indiana U Northwest	2	0	—	—			
Indiana U, South Bend	3	0	—	—			
Indiana U of Pennsylvania	12	4	3	—			
Indiana U-Purdue U							
Fort Wayne	1	6	—	—			
Indianapolis	1	12	13	—			
Interamerican U of Puerto Rico	2	5	—	—			
Iowa State U	8	4	4	34	46	14	6
Iowa, U of	16	2	4	8	14	1	3
Ithaca C	6	2	—	—			
Jackson State U	4	5	2	—			
James Madison U	8	8	—	—			
John Carroll C	5	14	5	—			
Johns Hopkins U	11	0	12	5	16	4	0
Juniata C	4	12	—	—			
Kalamazoo C	6	6	—	—			
Kansas State U	1	1	3	6	21	3	2
Kansas, U of	12	26	3	8	20	7	4
Kean C of New Jersey	4	13	—	—			
Kearney State C	1	18	—	—			
Kennesaw C	2	0	—	—			
Kent State U	16	4	2	4			
Kentucky, U of	7	12	3	7	20	6	1
Kenyon C	3	7	—	—			
King's C	4	1	—	—			
Knox C	0	16	—	—			
La Salle U	5	1	—	—			
Lafayette C	6	4	—	—	14	—	—
Lake Forest C	1	7	—	—			
Lamar U	5	0	4	—	32	8	0
Lawrence Technological U	14	0	—	—			
Lawrence U	3	3	—	—			
Le Moyne C	4	0	—	—			
Lebanon Valley C	1	5	—	—			
Lehigh U	3	3	5	15	25	12	12
Lewis & Clark C	1	0	—	—			
Lincoln U	0	6	—	—			
Long Island U							
Brooklyn Center	1	2	7	—			
C. W. Post Center	1	2	—	—			
Loras C	4	0	—	—			
Louisiana State U							
Baton Rouge	5	8	4	13	18	6	3
Shreveport	5	0	—	—			
Louisiana Technological U	1	4	0	—	12	3	—
Louisville, U of	5	15	2	8	—	18	3
Lowell, U of	4	5	6	13	20	3	—
Loyola C in Maryland	3	3	—	—			
Loyola Marymount U	4	0	—	—			
Loyola U							
Chicago	8	10	0	5			
New Orleans	0	4	—	—			
Luther C	0	8	—	—			
Macalester C	3	5	—	—			
Maine, U of	4	1	2	5	22	5	1
Manhattan C[c]	5	0	—	—	12	15	—
Manhattanville C	1	0	—	—			
Mankato State U	7	10	1	—			
Marietta C	2	1	—	—			
Marist C	1	1	—	—			
Marquette U	7	0	3	6			
Marshall U	3	14	0	—			
Maryland, U of							
Baltimore County	9	16	6	4	a		
College Park	16	39	10	24	33	1	5
Massachusetts Institute of Tech	31	0	2	55	32	38	42
Massachusetts, U of	7	3	8	13	22	4	11
McNeese State U	1	0	2	—			
Memphis State U	2	14	2	3			
Mercer U	0	2	—	—			
Merrimack C	7	0	—	—			
Metropolitan State C	3	18	—	—			
Miami U	16	33	6	6			
Miami, U of	2	19	3	2			
Michigan State U	15	17	11	28	39	8	3
Michigan Technological U	12	0	1	1	43	3	—
Michigan, U of							
Ann Arbor	28	0	18	26	54	10	9
Dearborn	9	13	—	—			
Flint	4	1	—	—			
Middle Tennessee State U	0	9	3	—			
Middlebury C	2	16	—	—			
Midwestern State U	1	8	—	—			
Millersville U	5	8	—	—			
Millsaps C	1	10	—	—			
Minnesota, U of							
Duluth	4	8	6	—			
Minneapolis	31	0	10	24	76	8	29
Mississippi C	4	9	—	—			
Mississippi State U	1	7	5	7	a		

	CHEMISTRY				CHEMICAL ENGINEERING		
	Bachelors certified						
	Yes	No	M.S.	Ph.D.	B.S.	M.S.	Ph.D.
Mississippi, U of	0	3	1	3	6	7	0
Missouri Western State C	7	2	—	—			
Missouri, U of							
Columbia	15	0	7	8	25	4	4
Kansas City	3	11	0	0			
Rolla	5	0	5	10	41	10	1
St. Louis	7	4	7	3			
Monmouth C	0	1	—	—			
Montana C of Mineral Science & Technology	2	4	4	—			
Montana State U	2	4	4	22	31	1	0
Montana, U of	3	3	3	3			
Montclair State C	3	8	1	—			
Moorhead State U	4	2	—	—			
Moravian C	2	6	—	—			
Morehouse C	4	1	—	—			
Morgan State U	3	3	—	—			
Mount Holyoke C	4	10	1	—			
Mount Saint Vincent, C of[c]	0	1	—	—			
Muhlenberg C	0	14	—	—			
Murray State U	2	10	4	—			
Muskingum C	0	8	—	—			
Nebraska, U of							
Lincoln	5	7	7	8	10	4	2
Omaha	7	1	—	—			
Nebraska Wesleyan U	2	2	—	—			
Nevada, U of							
Las Vegas	0	5	1	—			
Reno	2	3	1	2			
New Hampshire, U of	10	2	8	11		5	0
New Jersey Institute of Tech[b]						11	1
New Mexico Highlands U	0	0	0	—			
New Mexico Institute of Mining & Tech	6	0	3	2			
New Mexico State U	3	11	7	4	7	2	1
New Mexico, U of	3	8	4	7	9	4	2
New Orleans, U of	2	8	2	5			
New York U	0	31	5	14			
Niagara U	0	2	—	—			
North Alabama, U of	0	9	—	—			
North Carolina A&T State U	4	0	0	—			
North Carolina Central U	1	2	2	—			
North Carolina State U	25	40	5	7	69	4	7
North Carolina, U of							
Asheville	3	2	—	—			
Chapel Hill[c]	21	26	11	34			
Charlotte	8	5	3	—			
Greensboro	5	3	2	—			
Wilmington	5	11	0	—			
North Dakota State U	0	15	3	7			
North Dakota, U of	2	4	4	3	15	3	—
North Texas, U of	6	3	11	6			
Northeast Louisiana U	1	0	5	—			
Northeast Missouri State U	3	3	—	—			
Northeastern Illinois U	1	10	6	—			
Northeastern U	4	0	2	9	a		
Northern Arizona U	5	21	1	—			
Northern Colorado, U of	1	7	0	0			
Northern Illinois U	9	14	10	5			
Northern Iowa, U of	2	13	1	—			
Northern Kentucky U	3	4	—	—			
Northern Michigan U	2	3	0	—			
Northwest Missouri State U	1	0	—	—			
Northwestern State U	0	0	—	—			
Northwestern U	11	13	29	30	15	10	11
Notre Dame, U of	3	10	2	10	26	11	5
Oakland U	6	0	1	—			
Oberlin C	3	14	—	—			
Occidental C	13	7	—	—			
Ohio Northern U	3	3	—	—			
Ohio State U	43	0	23	31	38	18	4
Ohio U	3	15	2	1	16	5	0
Ohio Wesleyan U	2	2	—	—			
Oklahoma State U	3	1	7	11	10	6	4
Oklahoma, U of	10	13	14	9	14	8	6
Old Dominion U	5	6	7	—			
Oregon State U	9	0	0	13	a		
Oregon, U of	4	24	5	16			
Pace U							
New York	0	4	—	—			
Pleasantville	1	3	—	—			
Pacific Lutheran U	3	9	—	—			
Pacific, U of the	1	7	4	1			

	CHEMISTRY				CHEMICAL ENGINEERING		
	Bachelors certified						
	Yes	No	M.S.	Ph.D.	B.S.	M.S.	Ph.D.
Pennsylvania State U	10	11	1	23	95	12	3
Pennsylvania, U of	3	14	3	18	14	11	13
Philadelphia C of Pharmacy & Science	2	2	1	0			
Philadelphia C of Textiles & Science	3	0	—	—			
Pittsburg State U	0	2	1	—			
Pittsburgh, U of	14	54	6	17	25	14	10
Polytechnic U	0	1	11	19	4	11	4
Pomona C	2	6	—	—			
Portland State U	0	10	1	3			
Portland, U of	3	0	—	—			
Pratt Institute[b]					3	—	—
Princeton U	10	8	28	17	12	2	9
Providence C	3	1	0	0			
Puerto Rico, U of							
Mayaguez	4	13	5	—	66	11	—
Rio Piedras	17	33	5	6			
Puget Sound, U of	7	0	—	—			
Purdue U	14	14	11	50	92	7	17
Purdue U Calumet	0	5	—	—			
Ramapo C of New Jersey	1	0	—	—			
Randolph-Macon C	0	2	—	—			
Randolph-Macon Woman's C	1	6	—	—			
Redlands, U of	1	2	—	—			
Reed C	7	6	—	—			
Rensselaer Polytechnic Inst	21	0	13	9	35	5	6
Rhode Island C	5	1	—	—			
Rhode Island, U of	3	1	4	4	11	3	3
Rhodes C	4	3	—	—			
Rice U	3	1	11	16	10	3	9
Richmond, U of	0	11	—	—			
Rider C	1	0	—	—			
Ripon C	6	1	—	—			
Roanoke C	3	1	—	—			
Rochester Institute of Tech	5	18	7	—			
Rochester, U of	5	2	24	18	17	13	4
Rockhurst C	2	6	—	—			
Rollins C	0	6	—	—			
Roosevelt U	4	2	10	—			
Rose-Hulman Institute of Tech	9	0	—	—	34	0	—
Russell Sage C	1	0	—	—			
Rutgers U							
Camden C	3	4	—	—			
New Brunswick	9	26	12	19	31	12	10
Newark C of Arts & Sciences	4	6	7	3			
Saginaw Valley State U	3	10	—	—			
St. Anselm C	1	1	—	—			
St. Catherine, C of	5	4	—	—			
St. Cloud State U	4	12	—	—			
St. John Fisher C	3	0	—	—			
St. John's U/C of St. Benedict	4	11	—	—			
St. John's U	6	0	1	—			
St. Joseph C	0	2	3	—			
St. Joseph's U	15	6	4	—			
St. Lawrence U	2	7	—	—			
St. Louis U	11	24	6	—			
St. Mary's C	1	6	—	—			
St. Michael's C	1	1	—	—			
St. Olaf C	2	33	—	—			
St. Peter's C	1	1	—	—			
St. Thomas, U of	0	8	—	—			
St. Vincent C[d]	3	1	—	—			
Salem State C	0	0	—	—			
Sam Houston State U	7	4	4	—			
San Diego State U	21	5	8	2			
San Francisco State U	9	20	8	—			
San Francisco, U of	3	2	4	—			
San Jose State U	15	8	16	—	a		
Sangamon State U	2	0	—	—			
Santa Clara U	0	4	—	—			
Scranton, U of	3	10	9	—			
Seattle U	1	5	—	—			
Seton Hall U	5	7	14	5			
Seton Hill C[d]	0	0	—	—			
Shippensburg U	3	2	1	—			
Siena C	6	0	—	—			
Simmons C	0	3	—	—			
Skidmore C	0	10	—	—			
Smith C	3	4	—	—			
Sonoma State U	2	5	—	—			
South Alabama, U of[b]					13	0	—
South Carolina, U of	6	26	4	24	19	5	1

	CHEMISTRY				CHEMICAL ENGINEERING		
	Bachelors certified						
	Yes	No	M.S.	Ph.D.	B.S.	M.S.	Ph.D.
South Dakota School of Mines & Tech	6	1	2	—	18	1	—
South Dakota State U	1	14	4	0			
South Dakota, U of	0	5	2	—			
South Florida, U of	26	21	6	9	8	11	0
Southeast Missouri State U	3	8	—	—			
Southeastern Louisiana U	1	0	—	—			
Southeastern Massachusetts U	4	2	0	—			
Southern California, U of	12	4	6	16	15	4	2
Southern Colorado U	2	5	1	—			
Southern Illinois U							
Carbondale	4	4	4	3			
Edwardsville	2	2	8	—			
Southern Methodist U	3	7	0	—			
Southern Mississippi, U of	1	15	0	1			
Southern Oregon State C	2	5	—	—			
Southern U and A&M C	1	1	6	—			
Southwest Missouri State U	6	17	—	—			
Southwest State U	2	6	—	—			
Southwest Texas State U	11	0	5	—			
Southwestern Louisiana, U of	1	4	0	—	a		
Southwestern Oklahoma State U	3	5	—	—			
Stanford U	10	2	3	17	9	31	10
State U of New York							
Albany	7	3	4	9			
Binghamton	6	11	5	3			
Buffalo	13	10	8	14	28	8	7
Stony Brook	17	18	8	12			
C at Brockport	1	3	—	—			
C at Buffalo	2	7	2	—			
C at Cortland	1	4	—	—			
C at Fredonia	2	6	2	—			
C at Geneseo	3	4	—	—			
C at New Paltz	3	5	1	—			
C at Oneonta	0	8	0	—			
C at Oswego	12	2	2	—			
C at Plattsburgh	7	9	1	—			
C at Potsdam	0	9	—	—			
C at Purchase	2	4	—	—			
Stephen F. Austin State U	9	0	2	—			
Stetson U	1	2	—	—			
Stevens Institute of Tech	2	5	10	4	9	11	5
Stockton State C	1	8	—	—			
Suffolk U	2	3	—	—			
Susquehanna U	0	6	—	—			
Swarthmore C	8	4	—	—			
Syracuse U	8	3	3	10	7	2	6
Temple U	15	3	6	4			
Tennessee Technological U	4	4	2	—	11	6	0
Tennessee, U of							
Chattanooga	8	14	—	—			
Knoxville	5	13	8	15	32	13	3
Martin	5	4	—	—			
Texas A&I U	3	0	2	—	a		
Texas A&M U	8	13	7	42	58	13	6
Texas Christian U	1	9	1	3			
Texas Southern U	6	0	3	—			
Texas Tech U	9	12	3	9	a		
Texas, U of							
Arlington	9	6	6	5			
Austin	75	0	9	22	83	19	18
Dallas	5	0	2	4			
El Paso	12	0	9	—			
Texas Woman's U	1	2	2	—			
Thiel C	2	2	—	—			
Thomas More C	1	1	—	—			
Toledo, U of	7	7	6	4	10	11	2
Towson State U	2	2	—	—			
Trenton State C	16	0	—	—			
Tri-State U[b]					5	—	—
Trinity C	6	8	0	—			
Trinity U	3	7	—	—			
Tufts U	0	13	9	5	12	7	2
Tulane U of Louisiana	0	15	2	6	a		
Tulsa, U of	5	1	—	—	25	7	1
Tuskegee Institute	0	7	1	—	11	—	—
Union C	3	6	—	—			
U.S. Air Force Academy	12	0	—	—			
U.S. Naval Academy	14	0	—	—			
Ursinus C	5	6	—	—			
Utah State U	12	0	6	8			
Utah, U of	7	18	5	23	16	5	3
Valparaiso U	4	19	—	—			
Vanderbilt U	1	14	7	4	13	4	1
Vassar C	2	4	3	—			
Vermont, U of	8	0	1	5			
Villanova U	4	0	9	1	19	4	—
Virginia Commonwealth U	8	19	3	9			
Virginia Military Institute	6	0	—	—			
Virginia Polytechnic Institute & State U	17	8	10	19	30	2	4
Virginia, U of	6	64	5	7	29	27	8
Wabash C	6	4	—	—			
Wagner C	1	0	—	—			
Wake Forest U	16	0	4	1			
Washburn U	0	5	—	—			
Washington C	3	0	—	—			
Washington State U	4	4	9	9	13	13	0
Washington U	8	9	12	9	15	15	7
Washington, U of	29	14	19	20	51	11	10
Washington & Jefferson C	4	24	—	—			
Washington & Lee U	1	14	—	—			
Wayne State U	10	16	6	12	20	12	5
Waynesburg C	2	1	—	—			
Weber State C	4	2	—	—			
Wellesley C	4	17	—	—			
Wesleyan U	1	4	1	5			
West Chester U	6	17	2	—			
West Florida, U of	8	2	—	—			
West Texas State U	1	3	0	—			
West Virginia Institute of Tech[b]					5	2	—
West Virginia State C	4	3	—	—			
West Virginia U	5	33	3	3	18	4	2
Western Illinois U	2	5	3	—			
Western Kentucky U	3	16	5	—			
Western Maryland C	0	4	—	—			
Western Michigan U	2	15	1	0			
Western New England C	1	2	—	—			
Western Washington U	7	15	0	—			
Westminster C	0	3	—	—			
Wheaton C							
Illinois	6	4	—	—			
Massachusetts	3	4	—	—			
Wheeling Jesuit C	4	1	—	—			
Whitman C	0	2	—	—			
Whittier C	0	8	—	—			
Wichita State U	3	4	1	0			
Widener U	2	3	—	—	7	0	—
Wilkes C	5	1	—	—			
Willamette U	4	6	—	—			
William Paterson C of N.J.	0	4	—	—			
William and Mary, C of	26	6	5	—			
Williams C	3	19	—	—			
Winona State U	5	0	—	—			
Wisconsin, U of							
Eau Claire	2	4	—	—			
Green Bay	1	5	—	—			
LaCrosse	6	12	—	—			
Madison	22	4	10	47	85	9	13
Milwaukee	2	20	6	10			
Oshkosh	9	4	—	—			
Parkside	3	4	—	—			
Platteville	2	3	—	—			
River Falls	9	11	—	—			
Stevens Point	10	8	—	—			
Superior	0	4	—	—			
Wittenberg U	2	7	—	—			
Wooster, C of	4	14	—	—			
Worcester Polytechnic Institute	4	6	3	2	23	6	5
Wright State U	16	8	10	—			
Wyoming, U of	5	0	3	7	10	0	0
Xavier U	2	3	—	—			
Xavier U of Louisiana	0	25	—	—			
Yale U	0	11	21	30	1	0	7
Youngstown State U	10	39	3	—	a		
TOTALS	**3213**	**4437**	**1605**	**2131**	**3170**	**956**	**583**

Note: For brevity, "B.S." and "M.S." are used to denote all bachelor's and master's degrees, respectively, in each column. a Data not submitted. b Listed on basis of accreditation by AIChE-ABET. c The chemistry programs at Mount Saint Vincent and Manhattan College are integrated into a combined department with instruction in chemistry located at Manhattan College. d Saint Vincent College and Seton Hill College are integrated into a combined department. e UNC, Chapel Hill, Applied Curriculum in Chemistry degrees are combined with the chemistry department degrees.

Second group of 1991 ACS PRF grants approved

Acting on recommendations from the February meeting of the PRF Advisory Board, the ACS Board of Directors has approved 152 new or continuing ACS-PRF grants-in-aid. The board's action adds $4,095,505 to PRF commitments for 1991.

The new grants were recommended by the PRF Advisory Board from a total of 411 proposals. A third and final set of 1991 PRF grants will be announced this summer. Proposals for 1992 PRF grants are now being accepted. Applicants should note the revised limits for the scientific text of 4000 words for PRF Type AC and B proposals, and 1700 words for G proposals. For 1992 grants, the maximum salary and benefits that the principal investigator may receive each year will be increased to $5000, and the limit for travel will rise to $1000. Applicants from Ph.D. departments may request a $3000 supplement to involve an undergraduate in the research.

The "35th Annual Report on Research under Sponsorship of the Petroleum Research Fund" will be available in May. Individuals who wish a complimentary copy, or information and application forms for current ACS-PRF grant programs, should write Petroleum Research Fund, American Chemical Society, 1155—16th St., N.W., Washington, D.C. 20036, or call (202) 872-4481.

ACS-PRF Grants for Fundamental Research in the Petroleum Field (Type AC)

Alec M. Wodtke, U of California, Santa Barbara. State-Specific Effects on Intramolecular Vibrational Redistribution. $40,000

Viraht Sahni, City U of New York, Brooklyn C. Theory of the Inhomogeneous Electron Gas. $40,000

Joseph A. N. Zasadzinski, U of California, Santa Barbara. Electron Microscopy Investigation of Mechanisms of Vesicle Formation. $40,000

Jory A. Yarmoff, U of California, Riverside. Photon-Stimulated Desorption from Metal Halide Surfaces. $60,000

Richard J. Saykally, U of California, Berkeley. Measurement of the Electronic Spectrum of C_{60}. $40,000

Ti-Kang Kwei, Polytechnic U. Molecular Composites. $40,000

Thomas J. Kodadek, U of Texas, Austin. Mechanistic Studies of the Metal Porphyrin-Catalyzed Cyclopropanation of Alkenes. $40,000

Hugo Steinfink, U of Texas, Austin. The Crystal Chemistry and Physical Properties of Intergrowth Oxide Structures. $40,000

Edward C. Lim, U of Akron. Intermolecular Interactions in Aromatic Systems: the Structure and Dynamics of van der Waals Dimers, Excimers, and Bicimers. $40,000

David L. Freeman, U of Rhode Island. Solving Nonergodicity Difficulties in Classical and Quantum Simulations by J-Walking: Application to Cluster Alloys. $40,000

John H. Kennedy, U of California, Santa Barbara. Synthesis and Characterization of Conductive Glasses. $40,000

Andrew J. W. Gleadow, La Trobe U. Fission Track Thermochronology Studies of Post-Early Cretaceous Faulting, Uplift, and Unroofing of the Brooks Range, Alaska. $40,000

Geoffrey Davies, Northeastern U. Synthesis of Catalytic Alloys and Oxides. $40,000

Robert W. Murray, U of Missouri, St. Louis. Dioxirane Chemistry. $40,000

George C. Schatz, Northwestern U. Theoretical Studies of Molecular Photodissociation on Surfaces. $40,000

L. Neil Frazer, U of Hawaii, Manoa. Detection of Subsurface Fractures Using P-Wave Surface Seismic Data. $40,000

Brian E. Hanson, Virginia Polytechnic Inst. & State U. Solid-State Dynamics of Inorganic and Organometallic Solids. $40,000

Gerard Parkin, Columbia U. Synthetic and Mechanistic Studies of Electron-Rich Transition-Metal Complexes. $40,000

James A. Austin Jr., U of Texas, Austin. The Origin of the Southeastern United States Passive Continental Margin: Volcanic or Nonvolcanic. $40,000

Geraldine L. Richmond, U of Oregon. Comparative Studies of Single Crystal Surfaces in Solution and in UHV by Optical Second Harmonic Generation. $40,000

Arthur J. Ashe III, U of Michigan. Thermochromic Distibines and Related Compounds. $40,000

Mark A. Person, U of New Hampshire. Hydrologic Controls on Petroleum Generation within the Cooper and Eromanga Basins, Australia. $40,000

Jane E. G. Lipson, Dartmouth C. Polymer Solutions and Polymer Blends: a Theoretical Treatment of Compressible Mixtures Using Integral Equation Techniques. $40,000

John Weiner, U of Maryland. Experimental Studies of Cold and Ultracold Collision Dynamics. $40,000

James E. Barrick, Texas Tech U. Biostratigraphy of Silurian-Lower Devonian Strata, West Texas and Eastern New Mexico. $39,800

Renee D. Diehl, Pennsylvania State U. Defects on Metal Surfaces and Their Effects on Adsorbed Phases. $40,000

Jayanth R. Banavar, Pennsylvania State U. Flow-Through Porous Media. $40,000

David J. Bottjer, U of Southern California. Evaluation of Mesozoic and Cenozoic Cold Seep Faunas along the Northeast Pacific Convergent Margin. $40,000

Paul Knochel, U of Michigan. New Organometallic Reagents for Organic Synthesis. $40,000

Alexander J. Kresge, U of Toronto. Flash Photolytic Generation and Study of Reactive Species. $40,000

Charles H. DePuy, U of Colorado. Determination of Carbon-Hydrogen Bond Dissociation Energies in Simple Organic Molecules. $40,000

John S. Hutchinson, Rice U. Theoretical Studies of the Reactions and Spectroscopy of Highly Vibrationally Excited Molecules. $40,000

Douglas W. Stephan, U of Windsor. Early Metal Dithiolate Complexes: Macrocyclic Metalloligands. $40,000

Herbert Morawetz, Polytechnic U. Counterion Diffusion in Bulk Ionomers. $40,000

Timothy J. Bralower, U of North Carolina, Chapel Hill. Paleoceanography of the Early Cretaceous North Sea Basin. $40,000

Joseph M. O'Connor, U of California, San Diego. New Metallacycle Chemistry: Reactions with Carbenoid Reagents. $40,000

Donald W. Rogers, Long Island U, Brooklyn Center. Enthalpies of Hydrogenation. $40,000

David A. Kofke, State U of New York, Buffalo. A Novel Approach to Canonical Solutions. $40,000

M. Darby Dyar, U of Oregon. Detailed Crystal Chemistry of Iron-Bearing Phyllosilicates. $40,000

Edward R. Grant, Purdue U. Catalytic Reactions of Pulsed-Laser Prepared Organometallic Hydrides, Alkyls, and Carbonyls in the Gas Phase. $40,000

Thomas R. Dyke, U of Oregon. Structures of Aromatic Ring Van der Waals Complexes from Rotationally Resolved Infrared Spectra. $40,000

Timothy S. Zwier, Purdue U. Multiphoton Ionization Studies of Clusters of Immiscible Liquids. $40,000

Eric J. Amis, U of Southern California. Kinetics of Polymer Crystallization from Solution. $40,000

Hans-Rudolf Wenk, U of California, Berkeley. TEM Investigation of the Diagenesis of Silica Minerals. $39,770

Friedemann Freund, San Jose State U. Charge Distribution Analysis of MgO and CaO Catalysts Used in Oxidative Coupling of Methane. $40,000

Leslie J. Butler, Louisiana State U. Study of Zeolite Chemistry via NMR Imaging of Quadrupolar Nuclei. $40,000

Roger S. Macomber, U of Cincinnati. Synthesis of Molecules with Hidden Functional Groups. $40,000

James R. Chelikowsky, U of Minnesota. Theory of the Structural Properties of Semiconductor Clusters, Liquids, and Disordered Solids. $40,000

Bryant E. Rossiter, Brigham Young U. The Development and Investigation of Enantioselective Amidocuprate Reagents. $40,000

Michael F. Doherty, U of Massachusetts. Influence of Chemical Kinetics on the Design of Reactive Distillations. $40,000

William M. Reiff, Northeastern U. Donor-Acceptor Complexes of Iron Based on Fully Averaged, Mixed-Valent Aggregates with Novel Transport and Magnetic Properties. $40,000

Maitland Jones Jr., Princeton U. The Carboranylcarbene Rearrangement. $40,000

Marvin W. Rowe, Texas A&M U. Direct ^{129}I-^{129}Xe Dating of Petroleum. $40,000

Jose L. Martins, H. Ted Davis, U of Minnesota. Theory of Polymer-Metal Interfaces. $40,000

Robert Damrauer, U of Colorado, Denver. Gas-Phase Ion Molecule Studies on Aluminum-, Gallium-, and Silicon-Containing Anions. $60,000

Bruce E. Koel, U of Southern California. Chemisorption and Catalytic Reactions of Nitrogen Dioxide on Metal Surfaces. $40,000

Vemuri Balakotaiah, U of Houston. Spontaneous Ignition of a Coal Pile. $40,000

Thomas W. Scott, New York U. Time-Resolved Optical Harmonic Studies of Isomerization Dynamics at Interfaces. $40,000

Mark D. Hollingsworth, U of Alberta. A Scale of Functional Group Interaction Energies. $40,000

Paul J. Kropp, U of North Carolina, Chapel Hill. Surface-Mediated Electrophilic Additions. $40,000

Michael F. Herman, Tulane U. New Models for Polymer Dynamics in the Melt. $40,000

Edward L. Cussler, U of Minnesota. Pressure Swing Adsorption in Hollow Fibers. $40,000

David F. Kelley, Colorado State U. Interligand Electron Transfer in Transition-Metal Complexes. $40,000

Carl D. Hoff, U of Miami. The Heats of Binding of N_2, H_2, N_2H_2, N_2H_4, and NH_3 to Organomolybdenum Complexes. Thermochemical Models for Nitrogen Fixation. $40,000

Philip W. Choquette, U of Colorado. Origin of Porosity in Lime-Mud Dolomites. $39,935

Bruce H. Lipshutz, U of California, Santa Barbara. New Organometallic Chemistry of Al, Zr, Sn, and Cu. $40,000

Joseph L. Templeton, U of North Carolina, Chapel Hill. Chiral Transition-Metal Reagents for Organic Syntheses. $40,000

ACS-PRF Grants for Fundamental Research in the Petroleum Field (Type B)

Tami I. Spector, U of San Francisco. Synthesis and Investigation of Strained Cycloalkene Anions. $20,000

William J. Middleton, Ursinus C. New Methods and Reagents for Introducing Fluorine into Organic Molecules. $20,000

Kenneth Turnbull, Wright State U. Routes to, and Transformations of, Thionosulfites and Their Analogs. $20,000

Harold W. Heine, Bucknell U. The Chemistry of *o*-Quinone Monoimides. $20,000

Scott H. Northrup, Tennessee Technological U. Dynamics of DNA-Protein Association. $20,000

Kenneth M. Harmon, Oakland U. Spectroscopic and Thermodynamic Studies of Hydrogen Bonding Systems. $20,000

David W. Boykin Jr., Georgia State U. ^{17}O NMR Spectroscopy: Hydrogen Bonding Studies. $20,000

Merlyn D. Schuh, Davidson C. Heme Protein Dynamics Studied by Phosphorescent Probes. $20,000

Karen A. Singmaster-Hernandez, San Jose State U. Vibrationally Induced Bimolecular Reactions. $20,000

Lucjan Strekowski, Georgia State U. Chemistry of the Activated Trifluoromethyl Group. $20,000

Bruce N. Storhoff, Ball State U. The Synthesis and Study of Functionalized Crown Ether and Crown Thia Ether Molecules. $20,000

Mary F. Blackwell, Lawrence U. Plastoquinone Lateral Mobility in Relation to Linear Electron Transport Activity in Photosynthesis. $20,000

J. Dy..stra Eusden Jr., Bates C. Structural Geology of the Alpine Zone in the Presidential Range of New Hampshire. $20,000

Sunhee Choi, Middlebury C. Spectroscopic Studies on Stereochemistry and Coordination Behavior of Nickel Porphyrins. $20,000

Donald E. Linn Jr., Indiana U-Purdue U, Fort Wayne. Preparation and Solution Chemistry of Hexahydridoruthenate. $20,000

Luther E. Erickson, Grinnell C. Structural, Equilibrium, and Kinetic Studies of Platinum Complexes. $20,000

James H. Reynolds, Norwich U. The Magnetostratigraphy of Neogene Continental Strata in the Subandean Foreland Basin, Salta Province, Argentina. $20,000

Greg H. Mack, New Mexico State U. Calcareous Paleosols as an Indicator of Pliocene to Middle Pleistocene Paleoclimatic Changes in Southern New Mexico. $20,000

Edward Rosenberg, California State U, Northridge. Kinetics and Mechanisms of Carbon-Hydrogen Oxidative Addition Reactions in Alkyne Complexes of Trinuclear Clusters. $20,000

Richard L. Keiter, Eastern Illinois U. Studies of Phosphine Substitution in Carbonyl Complexes of Iron. $20,000

ACS-PRF Grants for Fundamental Research in the Petroleum Field (Type G)

Josef W. Zwanziger, Indiana U. Probing the Local Structure of Glasses with Nuclear Magnetic Resonance. $18,000

C. Michael Greenlief, U of Missouri, Columbia. Surface Processes in the Deposition of Germanium Films. $18,000

Peter W. Faguy, U of Louisville. The In-situ Study of Hydrogen Adsorption on Noble Metal Electrodes Using Dual- Beam FTIR Spectroscopy. $18,000

Stephen E. Creager, Indiana U. Scanning Tunneling Microscopy of Chemically Modified Gold Electrodes. $18,000

Gregory K. Farber, Pennsylvania State U. Crystallographic Studies To Determine the Structure and Function of Firefly Luciferase. $18,000

J. Thomas Brenna, Cornell U. High-Precision Stable Isotope Ratio Mass Spectrometry of Water Isotopes by Continuous Flow-Direct Liquid Introduction and Negative Ion Detection. $18,000

Michael J. Sailor, U of California, San Diego. Studies of Inorganic Complexes of Soluble, Electronically Conductive Polymers. $18,000

Timothy M. Swager, U of Pennsylvania. New Liquid Crystalline Ferroelectrics. $18,000

Michael J. Winokur, U of Wisconsin, Madison. Studies of Structure and Diffusion in Poly(3-alkylthiophenes). $18,000

Louis A. Coury Jr., Duke U. Electrochemical Probes of Ultrasonically Induced Cavitation. $18,000

Michael J. Therien, U of Pennsylvania. Photoinduced, Long-Distance Intramolecular Hole Transfer: An Experimental Approach. $18,000

Amir H. Hoveyda, Boston C. The Zirconium-Catalyzed Carbomagnesation Reaction. $18,000

Amitabha Chakrabarti, Kansas State U. Phase Separation in Polymeric Systems. $18,000

Glen W. Dillow, Cleveland State U. Studies of Organometallic Ion Chemistry Using High-Pressure and Electrospray Ionization Mass Spectrometry. $18,000

Chung F. Wong, City U of New York. Sensitivity Analyses in Dynamical Simulations of Biomolecular Systems. $18,000

Mark G. Kuzyk, Washington State U. Quadratic Electroabsorption in Doped Polymers. $18,000

Lutfur R. Khundkar, Northeastern U. Temperature- and Pressure-Dependent Studies of the Effects of Friction on the Dynamics of Electron Transfer Reactions. $18,000

Dorothy Sack, U of Wisconsin, Madison. Lacustrine Inflow Features of Lake Bonneville, Western U.S. $18,000

Francis C. Spano, Temple U. Theory of Excited State Dynamics in Molecular Aggregates. $18,000

Jiali Gao, State U of New York, Buffalo. Polarizable Intermolecular Potential Functions for Simulations of Interfacial Systems. $18,000

Chi Ho Mak, U of Southern California. Statistical Mechanics and Dynamical Processes on Surfaces. $18,000

Kurt Deshayes, Bowling Green State U. Cation Mediated Receptor. $18,000

Gordon M. Miskelly, U of Southern California. Synthesis and Chemistry of Sterically Hindered Water-Soluble Metalloporphyrins. $18,000

Apryll M. Stalcup, U of Hawaii, Manoa. Chiral Recognition Using Derivatized Cyclodextrins. $18,000

Bruce E. Bowler, U of Denver, Colorado Seminary. The Role of Hydrogen Bonds in Mediating Electron Transfer. $18,000

W. Grant McGimpsey, Worcester Polytechnic Inst. Multiphoton-Induced Electron Transfer Processes. $18,000

Russell J. Composto, U of Pennsylvania. Segregation-Induced Surface Modification in Polymers. $18,000

William J. Brittain, U of Akron. A Kinetic Investigation of Propagating Center Stabilization in the Living Polymerization of Methacrylates. $18,000

Alain S. Karma, Northeastern U. Theoretical Investigation of Eutectic Alloy Microstructure. $18,000

Marcelo H. Garcia, U of Illinois, Urbana-Champaign. Entrainment of Particles into Suspension in Turbulent Boundary-Layer Flows. $18,000

Bart Kahr, Purdue U. Origin of Anomalous Optical Anisotropy in Simple Salts. $18,000

David M. Birney, Texas Tech U. A "Molecular Scaffold" for the Study of Binding in Molecular Recognition. $18,000

David F. Naar, U of South Florida, St. Petersburg. Computer Modeling of Microplate Formation along a Divergent Plate Boundary. $18,000

John F. Damanti, Miami U. Erosion, Sediment Storage, and Transport in a Holocene Thrust Belt/Foreland Basin System, Argentina. $18,000

Barbara E. Stout, U of Cincinnati. Luminescence Studies of Eu^{3+} Binding in Synthetic Polyelectrolytes. $18,000

Xiangdong Zhu, U of California, Davis. An Experimental Study of Quantum Tunneling Diffusion on Surfaces: Hydrogen and Deuterium on Metals. $18,000

Michael J. Readey, Carnegie-Mellon U. In-situ Processing and Properties of Ceramic Composites. $18,000

Moungi G. Bawendi, Massachusetts Inst. of Technology. Spectroscopy of Chemically Synthesized Nanometer-Size Semiconductor and Diluted Magnetic Semiconductor Crystallites. $18,000

Rainer Glaser, U of Missouri, Columbia. Understanding Deamination Reactions. Development and Application of Electron and Spin Density Analysis. $18,000

Ali Borhan, Pennsylvania State U. The Effects of S.. factants on the Motion of Drops in Circular T..es. $18,000

P. Wipf, U of Pittsburgh. Design, Synthesis, and Application of Nonpeptidic Peptide Mimetics. $18,000

Patrick H. Vaccaro, Yale U. Spectroscopy and Dynamics of Energetic Transient Species. $18,000

Robert J. Davis, U of Virginia. Partial Oxidation of Methane over Au/TiO_2 Catalysts. $18,000

Elizabeth Glariowski-Kordesch, Ohio U. Global Geological Record of Lake Basins. $18,000

Karen S. Brewer, Hamilton C. Synthesis of Monomeric Gallium-Phosphorus Compounds. $18,000

Suzanne M. Amador, Haverford C. Fluorescence Microscopy of Pulmonary Surfactant Monolayers. $18,000

Patricia M. Kane, C of William & Mary. Coupling of ATP Hydrolysis and Proton Transport by the Yeast Vacuolar Proton-Translocating ATPase. $18,000

Paul A. Flowers, Pembroke State U. Infrared Spectroscopic Studies of Solubility and Partition Equilibria in Molten Salt/Supercritical Fluid Mixtures. $18,000

James W. Westgate, Lamar U. A Stratigraphic and Paleoecologic Analysis of Land Mammal-Bearing Eocene Strata on the Gulf Coastal Plain. $18,000

Lee R. Sharpe, Grinnell C. Investigation of the Relationship between Structure and Conductivity in Both Ion and Electron Conducting Polymers Containing Transition-Metal Ions. $18,000

Daniel R. Willey, Allegheny C. Microwave Pressure Broadening and Energy Transfer Studies, 2-100K. $18,000

Holly A. Harris, Creighton U. A Theoretical Investigation of the Reducing Abilities of a Series of Anionic Transition-Metal Hydride Complexes. $18,000

ACS-PRF Grants for Fundamental Research in the Petroleum Field (Type SE)

Joseph J. Gajewski, on behalf of Indiana U. Organic Chemistry, ACS national meeting, New York City, fall 1991. $2000

Ralph E. Sturgeon, on behalf of FACSS. Atomic Spectroscopy, 18th Annual Federation of Analytical Chemistry and Spectroscopy Societies Meeting, Anaheim, Calif., October 1991. $2000

Alison Butler, on behalf of the Regents of the U of California. Bioinorganic Chemistry of the Less Familiar Elements: Applications to the Marine Environment, ACS national meeting, New York City, fall 1991. $2000

Richard L. Martin, on behalf of the ACS Division of Physical Chemistry. New Developments in Superconductivity, ACS national meeting, New York City, fall 1991. $1000

Robert Tycko, on behalf of the ACS Division of Physical Chemistry. New Developments and Applications of Magnetic Resonance and Optical Spectroscopies, ACS national meeting, New York City, fall 1991. $1000

Mark D. Hollingsworth, on behalf of the U of Alberta, Canada. Chemistry of the Organic Solid State, 10th International Conference of the Chemistry of the Organic Solid State, Vancouver, British Columbia, Canada, July 1991. $2000

Jonathan L. Sessler, on behalf of the U of Texas, Austin. Bioinorganic Chemistry and Molecular Design, ACS national meeting, San Francisco, spring 1992. $2000

Henk L. C. Meuzelaar, on behalf of the U of Utah. Pyrolysis of Natural and Synthetic Macromolecules, ACS national meeting, Atlanta, spring 1991. $2000

William C. Stwalley, on behalf of the U of Iowa. Laser Science, 7th Interdisciplinary Laser Science Conference, Monterey, Calif, September 1991. $2000

Ripudaman Malhotra, on behalf of the ACS Division of Fuel Chemistry. Liquefaction Mechanisms, ACS national meeting, Atlanta, spring 1991. $2000 Mtg., Atlanta, April 1991. $2,000

Lance E. De Long, on behalf of the U of Kentucky Research Foundation. Rare Earth, 19th Rare Earth Research Conference, Lexington, Ky., July 1991. $2000

Martha K. Turckes, on behalf of ACS Project SEED. ACS Project SEED—Supplementary Program. $18,000

Terry A. Miller, on behalf of Ohio State U Research Foundation. Free Radicals, 21st International Free Radical Symposium, Williamstown, Mass., August 1991. $2000 □

ACS on indoor air pollution, other issues

ACS recently sponsored a special briefing for members of Congress and their staffs on issues and policies affecting indoor air pollution and transmitted its views on a number of current issues to Congress and certain regulatory agencies.

For the briefing sponsored in conjunction with the Congressional Environmental & Energy Study Conference, ACS provided four speakers to present scientific, technical, and engineering concerns relating to indoor pollution. They included Joan Daisey, director of the Indoor Environment Program at Lawrence Berkeley Laboratory, who discussed the scientific background for indoor air contamination. John Spengler, professor of the Harvard School of Public Health, reviewed what is known about the health effects of indoor air pollution, emphasizing that indoor air is different than outdoor air.

Jonathan Samet, chief of the pulmonary and critical care division at the University of New Mexico Department of Medicine, gave examples of known health problems from indoor air contamination and how carefully the issue must be examined to avoid health problems. Finally, Paul Cammer, president of the Business Council on Indoor Air, reviewed the building industry's perspective, which holds that most health problems are from biological factors such as mites and molds and that better maintained and operated building systems would solve many illnesses.

ACS sponsored the briefing because Congress has taken a very active interest in indoor air pollution this year, concentrating on the possibility that chemical contamination from construction and household products may be responsible for many complaints. Bills in the House (H.R. 1066) and the Senate (S. 455) would direct the Environmental Protection Agency to begin research programs on the sources and effects of indoor contaminants, among other provisions.

In a related matter, ACS urged EPA to consider nontraditional approaches in developing regulations defining laboratories as a "source" category as required by the Clean Air Act. The society suggests that each laboratory be required to draw up and adhere to an emission control work plan.

The plan, according to ACS, should outline procedures to minimize evaporation of chemicals, aerosol production, and particulate release. In addition, it should include a record of employee training and a regular internal evaluation program to ensure compliance and continued improvement in the reduction of emissions.

On the budget front, ACS told the House Subcommittee on Energy & Power that the Department of Energy's fiscal 1992 requested cut of 19% to $40 million for its six advanced coal research programs "would be disastrous." Cutting the programs seems to be directly counter to the actions required to fulfill the Administration's National Energy Strategy's goals for developing alternative fuels and finding environmentally sound ways to utilize the nation's vast coal reserves. ACS recommended that the coal research budget be set at a minimum of $60 million for 1992. In addition, the society recommended establishment of a $5 million competitive program for fundamental oil shale R&D.

The balance that needs to be struck between funding for space station *Freedom* and science-related programs at the National Science Foundation, EPA, and even the National Aeronautics & Space Administration, was addressed by ACS in a letter to the chairmen of the House and Senate appropriations' subcommittees that must make those decisions. The society made the point that in an era of fiscal constraint, any resources allocated to the space station should support important life sciences research, which has been identified as the station's primary objective. Further, ACS said it strongly believes that planned microgravity experiments on the station might be better and more economically completed on Earth or during Spacelab missions.

ACS also told the two chairmen, in a separate letter, that the proposed 13% increase for the EPA's Office of